The Great Plan for transformation of Nature:

A landmark environmental engineering project

(1948–1953)

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Toronto, Ontario

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Introduction

The Soviet Union was the world's largest country covering about one-sixth of Earth's land surface. It had a total land area of approximately 22,402,200 square kilometres. But only a fraction of this land, about 24.6–27.1 percent, was suitable for agricultural use. Agricultural land area in the country varied depending on the historical period. Between 1941 and 1980, it varied from 606.1 million ha to 606.8 million ha. Total arable land area during this period varied in the range 227.1–227.3 million ha. The share of arable land in the agricultural land area was 37.0–40.0 percent. The remainder was occupied by forages and permanent pastures.

Of the total arable land, a significant amount required some kind of reclamation – drainage, liming, gypsum application and soil protection from wind and water erosion There were also climatic and natural constraints to crop production. About one-third of the Soviet Union's territory was mountainous. Dry steppes (semi-arid ecological zones characterized by vast level grassland with no natural forest cover) and deserts occupied three million square kilometers, which constituted 14 percent of the surface area of the country. Grain crop production was concentrated in the Central Black Earth Zone of the RSFSR, the steppes of Ukraine and North Caucasus, Volga region, Southern Ural, Western Siberia, and Northern Kazakhstan.

Agriculture in the Russian empire and later in the Soviet Union were prone to frequent incidences of natural hazards. Drought, dry wind, dust/sand storms were the major ones. In years of drought, massive crop failures used to occur causing devastating famines. In the 18th century, there were 34 dry years in Russia, and in the 19th century, there were 40; on average, there was one dry year for every 3-4 normal years. In the twentieth century, droughts and drought-related famines and food shortages occurred in 1905, 1911, 1921/1922, 1932/1933, 1946/1947, 1963. The post-war reconstruction that began in 1946 was struggling to restore grain production to pre-war levels.

At that time, the country faced a severe drought that caused crop failure and drastic reduction of crop yields. It prompted the Soviet leadership to take an expansive long-term view of how to combat drought, dry winds and other climate-related hazards. The goal was to shield farming from the whims of nature and stabilize food production. The approach was decisive, innovative and without precedence. The strategy rested not on just managing environmental risks to crop production through adaptation, mitigation, or resilience as is the common practice today, but on overcoming them, conquering them.. And hence it had a short name in Russian " И Засуху Победим (We will conquer the drought, too)".

The programme was in effect the world's first attempted environmental engineering project extending over a large geographical area. Because the focus was on transformation of Nature impacting the agricultural areas in the target zones. It was done through harnessing the power of nature – trees, natural vegetation, water flow, soil fertility management through conservation agricultural practices. The project was the harbinger of the concept of Sustainable Agriculture, which the Food and Agriculture Organization of the United Nations (FAO) promoted when the Green Revolution was abandoned as the mainstream approach for increasing food production.

Launching of the Plan

The USSR Council of Ministers and the Central Committee of the All-Union Communist Party (Bolsheviks) at the initiative of Soviet leader Joseph Stalin adopted a resolution on 20 October 1948. It was titled as: "On a Plan of field-protective forest plantations, introduction of grassland crop rotation, the construction of ponds and water reservoirs to ensure high and sustainable yields in the steppe and forest-steppe regions of the European part of the USSR (О плане полезащитных лесонасаждений, внедрения травопольных севооборотов, строительства прудов и водоемов для обеспечения высоких и устойчивых урожаев в степных и лесостепных районах европейской части СССР)" – ." The Plan also became known as "the Grand Plan for Transformation of Nature" or "Stalin's Plan for Transformation of Nature".

ПРОЛЕТАРИИ ВСЕХ СТРАН, СОЕДИНЯЙТЕСЬ!

ВЕЧЕРНЯЯ МОСКВА

15 НОЯБРЯ 1948 Г. ПОНЕДЕЛЬНИК № 270 (7552) ЦЕНА 20 КОП.

ГАЗЕТА МОСКОВСКОГО ГОРОДСКОГО КОМИТЕТА ВКП(б) И МОССОВЕТА

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Сталинский план преобразования природы

С ОГРОМНЫМ воодушевлением встретил советский народ принятое по инициативе товарища

С. ЧЕРЕМУШКИН,
заместитель министра сельского хозяйства СССР

таров подвержены разрушительному действию водной эрозии. На этой площади свыше 10 миллионов гекта-

по берегам рек и озер, вокруг прудов и водоемов, а также облесение и закрепление песков;

правильная организация территории с введением травопольных полевых и кормовых севооборотов и рациональным использованием земельных угодий;

правильная система обработки почвы, уход за посевами и прежде всего широкое применение черных паров, зяби и лущения стерни;

правильная система применения

Вечерняя Москва (Moscow Evening), a newspaper published by the Moscow City Council, in its 15 November 1948 issue published an article (shown in the newsclip) in which the Deputy Agriculture Minister of the USSR, S. Cheremushkin provided the background and the technical details of the Plan[1]. The Minister described it as a grandiose plan for transforming nature, a plan for defeating drought, the perennial enemy of Russia's agriculture. It provided a road map to leap forward in the further development of agriculture and livestock farming in the steppe and forest-steppe regions in a time-frame of 10–15 years. The success would be reflected in high and sustainable crop yields and emergence of a strong forage basis for livestock farming.

[1] С. Черемушкин, Сталинский план преобразования природы, Вечерняя Москва, № 270 (7552), 15 Ноября, 1948 Г.

Drought and dry wind

As stated in the beginning, deserts occupied three million square kilometers, 14 percent of the surface area of theSoviet Union. Dry winds (суховеи), as a rule, originated in desert regions. Russian/Soviet scientists have long observed how dry winds and drought (засуха) produced destructive impacts on agriculture. The sultry breath of the deserts in Central Asia in the form of dry winds and droughts sometimes penetrated into the forest zones of the European part of Russia, often reaching the central black earth and, especially, the Rostov and Stavropol steppes, the south of Ukraine and the northern regions of Crimea, the Volga region, and the Ural region[2].
Dry wind worsened drought conditions by increasing evaporative demands and removing the remaining moisture from the soil surface. The dry soil surface could no longer dissipate the energy of incoming solar radiation through evaporation, and instead radiated the energy as sensible heat. It further warmed the surrounding land and air. In areas, where the landscape was flat and bare, dry winds on their path used to lift loose soil/sand particles turning into sand/dust storms wrecking havoc on standing crops and livestock. To address these issues, the plan presented a multipronged approach consisting of eight major actions[3].

I. The creation of a system of large state protective forest belts (По созданию системы крупных государственных защитных лесных полос)

The plan considered eight such forest belts, also known as shelterbelt forests[4]:

– From Saratov to Astrakhan, on both banks of the Volga River—two lanes, 100 metres wide and 900 kilometres long;

– In the direction of Penza-Ekaterinovka-VeshenskayaKamensk on the North Donets, on the watersheds of the Khopra and Medveditsa, Kalitva and Berezova rivers — three lanes spaced 300 meters, each 60 metres wide, and 600 kilometres long;

– In the direction of Kamyshin-Stalingrad, on the watershed of the Volga and Ilovli rivers—three lanes spaced 300 meters, each 60 meters wide and 170 kilometers long;

– In the direction of Chapaevsk-Vladimirovka – four lanes each 60 meters wide, spaced 300 meters apart and 580 kilometers long;

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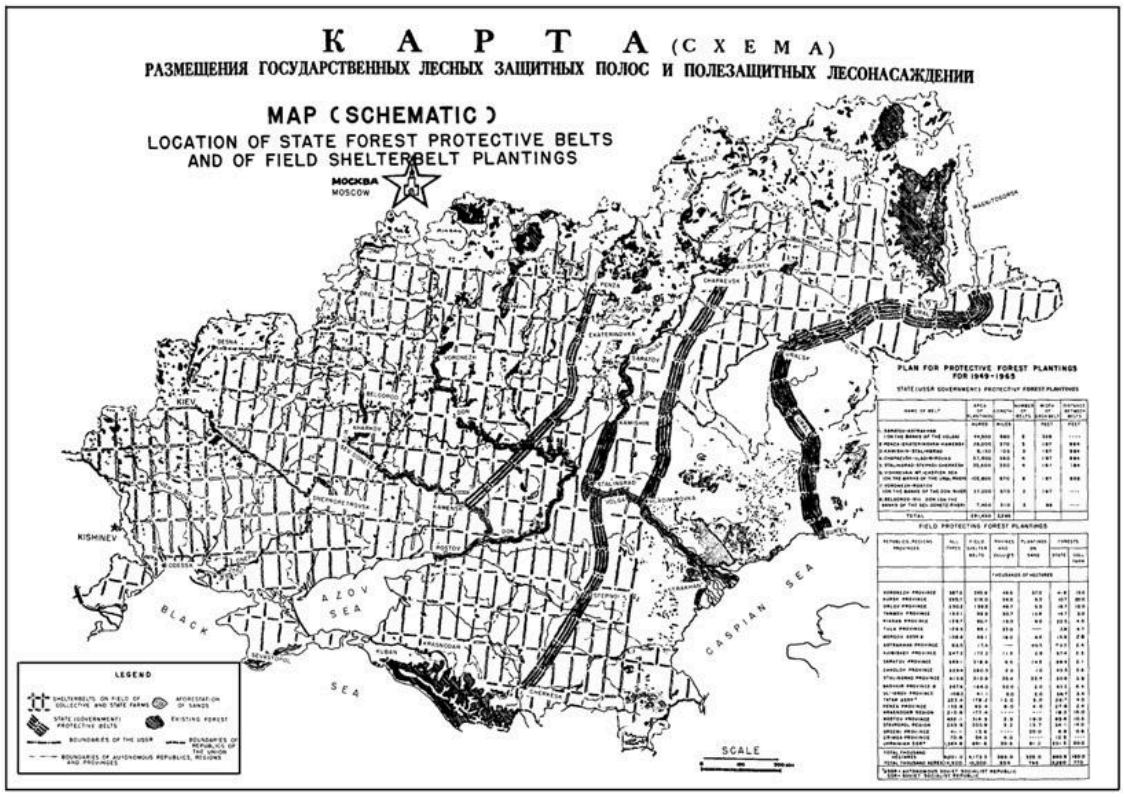
[2] Ковда В.А. 1952. Великий План Преобразования Природы. Издательство Академии Наук СССР.
[3] Постановление Совета Министров СССР и ЦК ВКП(б) от 20.10.1948 № 3960 https://ru.wikisource.org/wiki
[4] Владимир Николаевич Сукачёв. 1950. Сталинский План Преобразования природы. Академия Наук СССР.

– In the direction of Stalingrad-Stepnoy-Cherkessk—four lanes, 60 metres wide each, with a distance between the strips of 300 metres and a length of 570 kilometres;

– In the direction of Mount Vishnevaya-Chkalov-Uralsk- the Caspian Sea, along the banks of the Ural River — six lanes (three on the right and three on the left bank), each 60 meters wide with 200 meters between the lanes, and 1080 kilometers long. The schematic of state protective forest shelterbelt plantings is shown below:



– In the direction of Voronezh-Rostov-on-Don, on both banks of the Don River—two lanes, 60 metres wide and 920 kilometres long;

– On both banks of the North Donets River, from the city of Belgorod to the Don River, there are two lanes, 30 metres wide and 500 kilometres long.

The total length of large state protective forest belts was 5320 kilometres, forest planting area—117.9 thousand hectares.

The state forest protection zones outlined in this plan were divided into two types: watershed and water protection. Dividing forest strips extended along the most elevated spaces between the Ural and Volga rivers (Chapaevsk-Vladimirovka stripes), between the Volga and Don rivers (Kamyshin-Stalingrad-Stepnoye-Cherkessk stripes) and between the main tributaries of the Don

(Khoper-Medveditsa), and also between the Don and the North Donets rivers. Their main purpose was to protect against dry winds.
Water-protection forest strips were planted along the banks of the largest rivers of the southeast: the Urals, Volga, Don, and North Donets, were designed to regulate the water regime of these rivers.

The plan recommended the following tree species for planting the State forest shelterbelts:

a) For the state protective forest belt along the banks of the Volga River:
   - *on the Saratov-Stalingrad section*: on the right bank: the main tree species were oak, birch, and ash; on the left bank: the main species were oak, poplar, and ash; on both the right and left banks: accompanying were are common elm, small-leaved elm, Norway maple, and Tatarian maple; shrubs included were yellow acacia, Tatarian honeysuckle, rose hips, willow, and narrow-leaved oleaster;
   - *On the Stalingrad-Astrakhan section* – along the right bank of the Volga River: the main tree species were small-leaved elm, oak, ash, and maple; along the left bank of the Volga River: the main trees were oak, poplar, and small-leaved elm; along the right and left banks of the Volga River: accompanying trees are common elm, elm bark, and Tatarian maple; shrubs include tamarisk, narrow-leaved oleaster, willow, golden currant, and yellow acacia.

b) For the state protective forest belt *Penza - Ekaterinovka - Veshenskaya - Kamensk*: the main trees were: oak, birch, ash and Siberian larch; accompanying trees are Norway maple, Tatarian maple, linden, Norway elm, apple and pear; shrubs are yellow acacia, honeysuckle, smoke tree, golden currant and hazel;
c) For the *Kamyshin-Stalingrad state forest protection belt*: the main trees are oak, small-leaved elm, pine and ash; the accompanying trees are Tatarian maple, pear, apple and common elm; the shrubs are yellow acacia, honeysuckle, sumac, golden currant;

d) For the *state protective forest belt Chapayevsk - Vladimirovka*: the main trees are oak, birch, ash and small-leaved elm; accompanying trees are Norway elm, Tatarian maple; shrubs are yellow acacia, steppe cherry, tamarisk, narrow-leaved oleaster, Tatarian honeysuckle and golden currant;

e) For the *state protective forest belt Stalingrad - Stepnoy - Cherkessk:* main tree species were oak, ash, small-leaved elm, poplar, white acacia; accompanying trees – pear, apricot, Tatarian maple, apple, cherry; shrubs - tamarisk, willow, golden currant, yellow acacia;

f) for the *state protective forest belt Mount Vishnevaya - Chkalov - Uralsk - Caspian Sea*: main trees - oak, birch, elm, small-leaved elm, poplar, pine (on sand); accompanying trees - Tatarian maple, linden and willow; shrubs - yellow acacia, Tatarian honeysuckle, narrow-leaved oleaster, tamarisk;

g) for the s*tate protective forest belt along the banks of the Don River:* main trees - oak, birch, pine, ash, poplar, Siberian larch; accompanying trees - Norway maple, Tatarian maple, Norway elm, pear, apple, rowan, cherry, small-leaved linden; shrubs - hazel, Tatarian honeysuckle, smoke tree, yellow acacia, sea buckthorn;

h) For the *state protective forest belt along the banks of the Northern Donets River:* main trees - oak, birch, poplar, ash; accompanying trees - Norway elm, Norway maple, Tatarian maple, pear, apple, cherry; shrubs - yellow acacia, honeysuckle, smoke tree.

The plan also directed to plant eucalyptus in separate groves on state forest fund lands, as well as along the banks of rivers with other tree species in the Krasnodar Region, the Crimean Region and the southern regions of the Ukrainian SSR, in places favorable for the growth of eucalyptus. As evident the plan recommended not uniform but a diverse mix of timber tree species, fruit tree species and shrubs depending on the landscapes.

The objectives of the forest shelterbelts as stated in Resolution were:

- to protect agricultural crop yields from the destructive effect of dry winds on agricultural crop yields,
- to protect the fertile soils of the Volga region, the North Caucasus, and the Central Black Earth regions from being blown away (wind erosion), and
- to improve the water regime and climatic conditions of these areas.

The plan set a timeline of 15 years for creating the state forest belts over the period 1950–1965:

II. " The development of protective forest plantations in the fields of collective and state farms (По развитию защитных лесонасаждений на полях колхозов и совхозов).

Besides the large state forest shelterbelts, the plan also envisaged a second tier of shelterbelts on the field margins of state farms and collective farms.

It set the target for the creation of protective forest plantations on an area of 5,709 thousand hectares (5.79 million ha) of cropland. It included 3,592.5 thousand hectares (3.59 million ha) to be planted by the efforts and means of collective farms with assistance provided by the state. The USSR Ministry of Forestry was tasked with planting 1,536.5 thousand hectares (1.54 million ha). Of this amount 960.5 thousand hectares were in sparsely forested areas on the lands of the state forest fund and 576.0 thousand hectares on the lands of collective farms with the labor participation of collective farmers. The State farms were assigned 580 thousand hectares with support provided by the USSR Ministry of State Farms. The planting targets were broken down by republics and regions.

The stated objectives of the farm-level shelterbelts were:

- to protect the crops from the adverse effects of dry winds;

- to improve the water regime and prevent water erosion and wind erosion of the fertile top soil in the steppe and forest-steppe regions of the European part of the USSR.

The plan recommended the following tree and shrub species for the creation of collective and state farm shelterbelts.

a) on deep leached chernozems of the Ukrainian SSR: primary species — oak, birch, Siberian larch, poplar, ash, and Scots pine (on sandy areas); secondary species—Norway maple, small-leaved linden, pear, and apple; shrub species—cotinus, euonymus (except in sugar beet-growing areas), and golden currant;

b) on ordinary chernozems of the Ukrainian SSR: main trees - oak, birch, honey locust, ash, Scots pine (on sand); accompanying trees - Norway maple and field maple, small-leaved linden, pear, apricot; shrubs - smoke tree, golden currant;

c) In the southern chernozems of the Ukrainian SSR and the Crimean region: the main ones are oak, honey locust, green and common ash, white acacia; accompanying ones are Norway maple and field maple, apricot, pear, apple; shrubs are golden currant, smoke tree, privet;

d) On dark chestnut soils of the Ukrainian SSR and the Crimean region: the main ones are oak, honey locust, green ash, white acacia; accompanying ones are Tatarian maple, apricot, cherry plum; shrubs are golden currant, smoke tree, privet;

e) On the soils of the chestnut-solonetz complex of the Ukrainian SSR and the Crimean region: the main one is honey locust; shrubs are oleaster, smoke tree, golden currant, tamarisk, amorpha;

f) On deep and leached chernozems of the Tula, Oryol, Tambov, Kursk, Ryazan, Penza, Voronezh, Saratov, Ulyanovsk, Kuibyshev regions, the Mordovian and Tatar ASSR: the main ones are oak, birch, Siberian larch, Scots pine (on sand), ash; accompanying ones are Norway maple, small-leaved linden, pear, apple;
g) On ordinary chernozems of the Voronezh, Stalingrad and Saratov regions: the main ones are oak, birch, ash, Scots pine (on sand); accompanying ones are Norway maple, small-leaved linden, pear, apple, cherry; shrubs are golden and black currant, Tatarian honeysuckle, rose hips, hazel;

h) In the southern chernozems of the Stalingrad and Saratov regions: the main trees are oak, ash, birch, and Scots pine (on sand); accompanying trees are Norway maple, pear, and apple;

i) In the southern chernozems of the Rostov region and Stavropol territory: the main ones are oak, honey locust, ash, white acacia; accompanying ones are Norway maple and field maple, apricot, pear, apple; shrubs are golden currant, smoke tree, privet;

j) On dark chestnut soils of the Stalingrad region: main trees are oak, green ash, white acacia, Scots pine (on sand); accompanying trees are Tatarian maple, pear; shrubs are golden currant, Tatarian honeysuckle;

k) on light chestnut complex soils of the Astrakhan, Stalingrad, Rostov, Grozny regions and Stavropol Krai: main plants are small-leaved elm, white acacia; accompanying plants are Tatarian maple, white mulberry; shrubs are golden currant, narrow-leaved oleaster, tamarisk;

l) On the dark soils of the valleys of the Stalingrad and Astrakhan regions: the main ones are oak and ash; the accompanying ones are small-leaved elm, pear, Tatarian maple; shrubs are golden currant, Tatarian honeysuckle;

m) in the Azov and Ciscaucasian chernozems of the Krasnodar, Stavropol territories, Rostov and Grozny regions: the main ones are oak, honey locust, ash, white acacia; accompanying ones are Norway maple and field maple, linden, pear, hornbeam, white mulberry, apricot; shrubs are golden currant, sumac, dogwood;

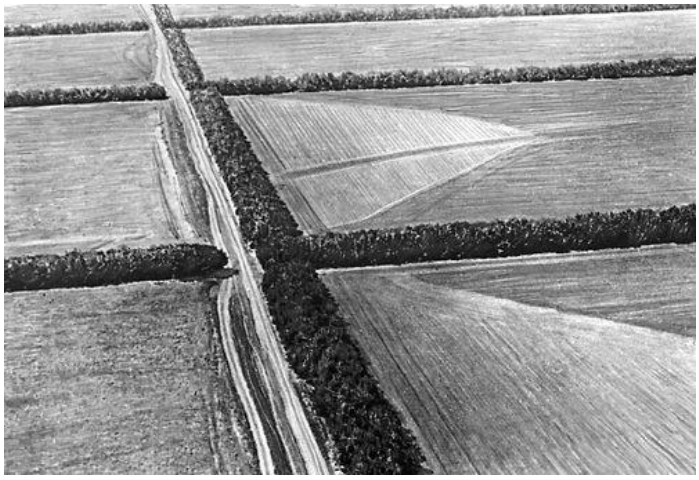
n) On the deep chernozems of the Ulyanovsk and Kuibyshev (Trans-Volga) and Chkalov regions, the Tatar and Bashkir ASSRs: the main trees are oak, birch, Siberian larch, ash; accompanying trees are Norway maple, small-leaved linden, apple, and pear

o) On the carbonate chernozems of the Bashkir ASSR: the main trees are birch, oak, small-leaved elm; accompanying trees are Norway elm, Tatarian maple, Siberian apple; shrubs are golden currant, yellow acacia;

p) on ordinary chernozems of the Kuibyshev, Saratov, Chkalov regions and the Bashkir ASSR: main trees are oak, birch, Siberian larch, ash; accompanying trees are Norway maple, small-leaved linden, Tatarian maple, apple, pear; shrubs are golden currant, sea buckthorn, Tatarian honeysuckle;

q) in the southern chernozems of the Saratov, Kuibyshev and Chkalovsk regions: the main ones are oak, small-leaved elm, ash; accompanying ones are Norway and Tatarian maple, common elm, Siberian apple, pear; shrubs are golden currant, Tatarian honeysuckle, yellow acacia;

r) On dark chestnut soils of the Saratov, Stalingrad and Chkalov regions: the main trees are small-leaved elm and green ash; accompanying trees are Tatarian maple, apple and pear; shrubs include golden currant and yellow acacia. A snapshot of farm-level shelterbelts is shown below:



A snapshot of field-protective forest shelterbelts is shown above. The recommendation of tree species for planting along the field margins was made based on ecological zoning and location-specific consideration of soil characteristics.

III Stabilization and afforestation of sand (По закреплению и облесению песков)

This component dealt with anchoring sands and preventing desertification of agricultural crop lands. Its stated objective was to prevent the movement of sand in the steppe and semi-desert regions onto the fertile lands of the Volga region, the North Caucasus, the Central Black Earth regions, and the Ukrainian SSR. The plan mandated the USSR Ministry of Forestry to stabilize and afforestate sands over an area of 322,000 hectares between 1949 and 1955. Tree and shrub species recommended for sand afforestation varied depending on ecological zoning:

a) Forest-steppe zone – Scots pine, birch, oak, poplar, yellow acacia, Tatarian honeysuckle, and willow;

b) Steppe zone – Scots pine, Crimean pine, white acacia, oak, poplar, apricot, white mulberry, yellow acacia, smoke tree, narrow-leaved oleaster, Tatarian honeysuckle, willow, and amorpha;

c) Semi-desert zone – white acacia, small-leaved elm, oak, poplar, white mulberry, apricot, narrow-leaved oleaster, smoke tree, tamarisk, calligonum, willow, and pine.

A snapshot of afforestation of sandy areas is shown below:

IV. Growing planting material in state, collective and state farm forest nurseries (По выращиванию посадочного материала в государственных, колхозных и совхозных лесных питомниках)

The stated objective of this component was to ensure that state, collective farm and state farm forest nurseries produce the required quantities of quality seedlings of tree, shrub and fruit species for use in

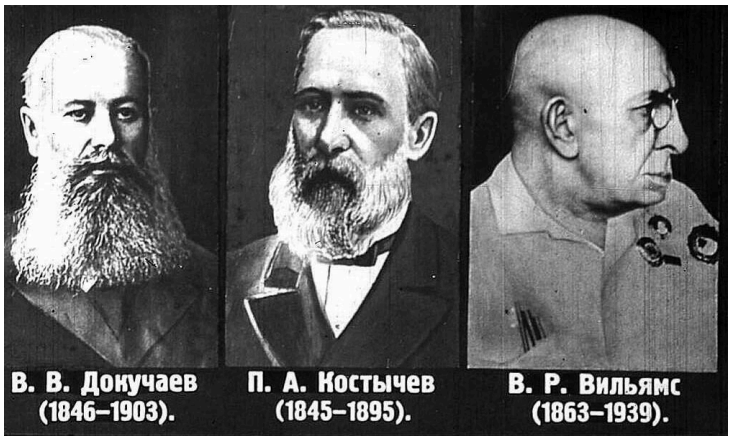
creating state, collective farm and state farm protective forest belts and to afforestate ravines, gullies, and the shores of lakes and rivers in the steppe and forest-steppe regions of the European part of the USSR. The plan set the target of producing seedlings at 2886 million units in 1949, 4161 million units in 1950, and 26,685 million units over 1951–1955 in state nurseries.

V. The introduction and development of grassland crop rotations (По введению и освоению травопольных севооборотов)

This component sought to introduce grassland crop rotations[5] in collective and state farms. Protective forest belts at landscape and field levels along with grassland crop rotations constituted the core of climate modification efforts. The stated objectives were to increase the yield of agricultural crops, create a sound feed base for livestock farming and increase labour productivity in collective and state farms. Grassland crop rotation was also a model for crop-livestock integrated farming systems.

The plan directed the USSR Ministry of State Farms to complete the introduction of grassland crop rotations in all state farms in the steppe and forest-steppe zones of the European USSR by 1949. It also directed the USSR Ministry of Agriculture and local Soviet and Party bodies of the republics, territories, and regions of the steppe and forest-steppe zones of the European USSR to complete the introduction of grassland crop rotations in all collective farms where this work had not yet been carried out, no later than 1950, showing the distribution of targets by republic, territory, and region.

Grassland crop rotations in the plan for transforming nature were a farming system in which part of the arable land was sown with perennial legumes and bluegrasses (e.g., alfalfa, sainfoin, and brome grass). This system was developed by Russian scientists V.V. Dokuchaev, P.A. Kostychev, and V.R. Williams. (shown in the photo below from left to right)



[5] Crop rotation is a planned alternation of grain crops, industrial crops, perennial and annual grasses and fallow land on the same plot of land.

In grassland crop rotations, grain crops were returned to fields previously occupied by forage crops (perennial grasses) after 2–4 years — the exact time depended on the crop rotation scheme, the type of grass, and regional agronomic recommendations. Grassland crop rotations were assigned an important role in the transformation of nature because they restored soil fertility. Perennial grasses enriched the soil with organic matter, improving its structure and nutrient composition, which helped reduce the soil depletion typical of monocultures.

VI The development of irrigation, construction of ponds and reservoirs (По развитию орошения, строительству прудов и водоемов)

This component sought to develop surface water-based irrigation systems in collective and state farms utilizing local run-off waters. For this purpose, the plan mandated construction of 44,228 ponds and reservoirs in the farms in natural depressions, at the sources of rivers, in the upper reaches of gullies and ravines and in other natural depressions. Collective farms were assigned construction of 41,300 and state farms 2,928 ponds and reservoirs. The plan also considered the construction of reservoirs on small rivers to regulate and use local water flow for irrigation, fish farming and the generation of hydroelectric power for agricultural needs. The picture below illustrates this approach.

VII. Mechanization of agricultural work, forest planting and construction of ponds and reservoirs (По механизации сельскохозяйственных работ, лесопосадок и строительства прудов и водоемов)

This component of the plan required the USSR Ministry of Agriculture and the USSR Ministry of Forestry (to organize 570 forest protection stations in 1949–1951 in the regions covered by the plan. The stated objectives of this component was to oversee the extensive mechanization of labor-intensive work on protective afforestation and pond construction.

Shelterbelts served several functions. They reduced wind speed and moisture evaporation, retained snow, increasing its storage in the soil, and prevented soil erosion and the spread of gullies and ravines. . Furthermore, the shelterbelts served as migration corridors for animals and birds and attracted pollinating insects.

VIII The establishment of the Main Directorate for Protective Afforestation under the Council of Ministers of the USSR (О создании Главного управления полезащитного лесоразведения при Совете Министров СССР)

This component of the plan created a separate administrative unit under the USSR Council of Ministers called the Main Directorate of Field-protective Forestry. It was entrusted with exercising oversight on all forest shelterbelt planting and afforestation activities carried out across various ministries, departments and agricultural farms to ensure compliance with the targets and timelines set by the government in the Grand Plan for transformation of Nature.

The science behind the Plan

The Grand Plan for the transformation of Nature didn't emerge from a blank slate. It drew on decades of research conducted by noted Russian soil scientists, agronomists, landscape farming and forestry scientists as well as practical experience gained through extensive field testing. The main research organization whose research findings and practical experiences were used as key inputs in development of the plan was the V. V. Dokuchaev Kamenno-Stepnaya Experimental Station established in 1911. which in 1946 was reorganized into V.V. Dokuchaev Agricultural Institute in the Central Blackearth Zone (Институт земледелия Центрально-Чернозёмной полосы имени В. В. Докучаева). A snapshot of the institute and experimental fields is shown below:

The first forest belts established in Kamennaya Steppe were very wide: 100–80–60 m. The width of the strips was reduced later to 30–60 m. A 60-meter wide strip was found to absorb spring runoff and completely halt soil erosion. The planners took into account the experience of the Kamennaya experimental station with regard to row spacing. Planting forest in narrow strips in areas with highly rugged terrain and high melt and rainwater runoff was found inappropriate. Because these strips were insufficient to protect the soil from erosion and runoff. In the plan, the width of the strips is set at 10–20 meters in flat areas, and 20–60 meters in rugged terrain where soil erosion must be stopped. For state-owned protective forest belts, the prescribed width was 60–100 meters (only for belts along the Donets River – 30 meters). The other relevant scientific findings and observations with regard to protective forest belts were the following[6]:

The forest belts in the Kamennaya Steppe dramatically altered its natural appearance, particularly its water regime, temperature, and humidity. Droughts, so common on the collective farms located around the V.V. Dokuchaev Institute, began to completely bypass the transformed Kamennaya Steppe. According to observations over the past decades, the average annual precipitation in the forest belt area was 450 mm, while in the open steppe nearby, it was 400 mm. Snow used to melt in the forest belt area 5 to 13 days later than in the adjacent steppe thus allowing more moisture to be stored in the soil. The soil in the fields between forest belts had a much larger reserve of snow water than the fields of open steppe: in the steppe 46–52 mm, in the fields between forest belts 64–80 mm, at the edge of forest belts 197–303 mm and inside forest belts 116–251 mm. In spring, the groundwater level in the steppe roses by 0.61 m, in the fields between the strips – by 0.79 m, in the forest strip – by 1.56 m and at its edge – by 1.60 m.

Thus, forest belts became "storage basins" for moisture, which they gradually (in spring and summer) release to the fields enclosed within the square of shelterbelts. The forest belts bordering the fields also created a unique climate – evaporation from these fields was half that of a field in the open steppe; relative humidity was 3-5 percent higher than in the steppe; and wind speed was reduced by 35-40 percent. The grassland crop rotations introduced in the Kamennaya Steppe, over a period of ten years, transformed the structure of the local chernozem soils into a strong fine-grained structure. They restored natural soil fertility. The content of humus in the local chernozem soils increased from 7.3 percent to 8.7 percent and that of nitrogen from 0.355 percent to 0.435 percent. The changed natural conditions also contributed to species diversification of the local fauna from 47 bird species to 167 species.

The introduction of the grassland farming systems led to consistent increase of the yield of grain and other crops. It was evident from varying levels of grain yield depending on the use of the components of grassland farming systems practices. Grain yield harvested was 1.68 t/ha with proper soil preparation

[6] Лесная-Лыжина Е. В. 2018. Сталинский план преобразования природы и его осуществление на Южном Урале.https://www.litres.ru/book/elena-lesnaya-lyzhin/stalinskiy-plan-preobrazovaniya-prirody-i-ego-osusche-38011410/chitat-onlayn/

and sowing with selected seeds. It increased to 1.80 t/ha when grasses were sown in rotations in the fields, when grown under forest belts yield increased to 2.53 t/ha. Finally the application of the full technology package – the correct use of mineral and organic fertilizers during sowing with selected seeds, sowing grasses in rotation, and the creation of forest belts increased the yield to 3.05 t/ha.
In the exceptionally dry year of 1946, the fields of Kamennaya Steppe yielded 16.5 centners (1.65 t/ha) of winter wheat, 15 centners (1.5 t/ha) of winter rye, 10.6 centners (1.06) of spring wheat, 15.8 centners (1.58 t/ha) of oats, and 21.2 centners (2.12 t/ha) of sunflower per hectare. In neighboring collective farms located in the open steppe yields of these crops were three to four times less. Some of these results are shown in the Table below:

Влияние лесных полос на урожай зерновых культур в травопольном севообороте института (в центнерах с га).

Культура	Годы	Лесные полосы	В степи
Озимая пшеница Гостианум 237	1946 1947	16,5 20,3	8,9 15,1
Яровая пшеница Лютесценс 62	1946 1947	10,6 20,5	7,6 16,3
Овес советский	1946 1947	9,5 20,1	6,4 15,8
Ячмень Нутанс 187	1947	33,7	24,3

The Table is titled “Effect of forest strips (windbreaks) on the yield of grain crops grown in grassland crop rotation of the institute” over the years 1946–1947. The first column lists the crops – winter wheat (var. Gostianum 237), spring wheat (var. Lutescens 62), oat (var. Sovietsky), and barley (var. Nutans 187). The third column shows yields under forest strips, and the fourth column yields in the steppe (in barren land). Yields are reported in centners/ha equivalent to 0.1 t/ha. As evident, winter wheat produced yield 46.1 percent (16.5-8.9/16.5 x 100) more under windbreak than in the steppe in 1946 (hit hardest by drought) and 25.6 percent more (20.3-15.1/20.3 x 100) in 1947. It was notable that even in an exceptionally drought year 1946, yield obtained was 1.65 t/ha, which was higher than the national average. Similarly, spring wheat produced 1.06 t/ha yield in 1946 and 2.05 t/ha in 1947 under windbreak. These yields exceeded those obtained in the steppe by 20.5–28.3 percent. The yield of barley in 1947 was 3.37 t/ha under windbreak which exceeded the yield obtained in the steppe by 27.9 percent.

In the Kamennaya Steppe, ravines grew year after year. Currently, the process of soil erosion and ravine growth has almost completely stopped. The forest belts absorb moisture like sponges. Previously, before the belts were planted, 70 percent of the water ran off the surface causing soil erosion; now, less than 1 percent does. V.V. Dokuchaev himself planted a forest along the slopes of the Khorolsky Ravine; now the ravine's growth has stopped, and it has become a forested ravine.

Kamennaya Steppe isn't the only place where the Dokuchaev-Kostychev-Williams method was widely used. During the five-year plans, this method was disseminated to many agricultural farms. The famous state farm, Gigant (meaning Giant) in the Rostov region was one of the early adopters. Collective farms in the Selsky District of the Rostov region , and many collective farms in the Stalingrad region also adopted this method . The Figure below illustrates grain yields obtained by one such collective farm “Stalin” between 1944 and 1948. The yield improvement over a period of five years was quite significant – from 1.3 t/ha to 2.0 t/ha.

According to data from the Institute of Forestry of the USSR Academy of Sciences, processed by P. V. Vasiliev, forest belts contributed to the following increase in grain crop yield:

Культуры	Число наблюдений	Прибавка урожая, в процентах			
		в годы повышенной урожайности	в годы средней урожайности	в годы низкой урожайности	в среднем
Рожь озимая	16	43	90	200	56
Пшеница озимая	24	40	54	191	54
Пшеница яровая	20	27	35	90	44
Овес	20	38	86	85	59
	80	39	63	119	53

The first column of the Table lists crops – winter rye , winter wheat, spring wheat and oat. The second column shows the number of observations taken. The common title of the third column – increase in yield in percent. The third sub-column shows figures for the years with high yields, the fourth sub-column shows figures for years with medium yields, the fifth for the years with low yields, and the fifth sub-column shows average of all years. As evident from the Table, averaged for all crops, highest yield increase occurred in years with low yields, followed by years with medium yields and high yields. On average, yield increases attributable to forest shelterbelts varied from 44 percent to 59 percent.

According to experimental data from the All-Union Research Institute of Agroforestry and Forestry (VNIALMI), in the Trans-Volga region, the average snow depth in open steppes in 1946–47 was 12 centimeters, while in areas protected by forest belts, it was 21–22 centimeters. Thus, forest stands significantly reduce wind strength and increase moisture in both the soil and the air. This creates conditions for higher and more stable harvests than in the open steppe.

Based on these research results and the experiences of advanced agricultural farms, the Soviet Government launched the ambitious Grand Plan for the transformation of Nature. It was reflected in introduction of the document as follows:

“The USSR Council of Ministers and the Central Committee of the All-Union Communist Party (Bolsheviks) note that frequently recurring droughts and dry winds in the steppe and forest-steppe regions of the European part of the USSR cause significant damages to the agriculture of these regions. At the same time, science has proven, and the practice of leading collective farms, state farms, machine tractor stations (MTS) and districts has confirmed, that with proper farming in these areas, there is every opportunity to obtain high and stable yields of agricultural crops and create a solid forage base for the development of livestock farming.
To achieve this, all collective and state farms in the steppe and forest-steppe regions, based on the long-term experience of a number of research institutes and leading collective and state farms, beginning in 1949, must begin the systematic and widespread implementation of a system of agronomic measures to improve agriculture, based on the teachings of the leading Russian agronomists V.V. Dokuchaev, P.A. Kostychev and V.R. Williams, known as the grassland farming system (shown in the photo below), which includes:

a) planting protective forest belts on watersheds, along the boundaries of crop rotation fields, on the slopes of gullies and ravines, along the banks of rivers and lakes, around ponds and reservoirs, as well as afforestation and sand stabilization;
b) proper land management with the introduction of grassland and forage crop rotations and rational use of land;
c) a proper system of soil cultivation, crop husbandry, and, above all, the widespread use of bare fallow, autumn ploughing for sowing in the spring, and stubble incorporation;
d) a proper system of application of organic and mineral fertilizers;
e) sowing selected seeds of high-yielding varieties adapted to local conditions;

f) developing irrigation based on the use of local runoff water through the construction of ponds and reservoirs.

As highlighted before, the design of the eight forest shelterbelts was not a standard one for all ecological zones. The number of rows, row spacing, interspacing among the rows as well as tree species selection in the shelterbelt varied widely depending on the ecological zone. This design wasn't an improvised one but drew on twenty years of agroforestry research and field testing in the Astrakhan semi-desert area. In 1925, literally from scratch, a research station called the Bogdinsky Agroforestry Reclamation Base was founded which in 1933 became affiliated with the All-Union Institute of Agroforestry Reclamation. In 1925, in extremely dry conditions, scientists and foresters planted the first hectares of young trees with their own hands. It was here that, from hundreds of tree and shrub varieties, tree species were selected that met the scientific developments of Dokuchaev and Kostychev for Russia's natural conditions.

Their efforts were rewarded with success. The forest grew on the semi-desert steppe. While temperature in the open steppe reached 53 degrees Celsius, the shade of the trees was 20 percent cooler, and soil evaporation was reduced by 20 percent. Observations in the Buzuluk forestry (one of the five outposts of the research station) in the winter of 1928-1929 showed that a 7.5-meter-tall pine tree accumulated 106 kg of frost in that winter. This means that a small grove can "extract" several tens of tons of moisture from precipitation. The plan also drew on research done by G.N. Vysotsky, an academician at the All-Union Academy of Agricultural Sciences (VASKhNIL), who studied the influence of forests on the hydrological regime. He was the first to calculate the moisture balance under forests and fields, and investigated the impact of forests on habitats and the causes of steppe deforestation. Vysotsky also made a significant contribution to steppe afforestation. He studied the relationship between forests and virgin steppe lands, field plots, groundwater levels, forest cover, and microclimate. He also investigated the influence of forest shelterbelts on snow accumulation and crop yields. Collective farmers and forestry workers harvested 6,000 tons of tree and shrub seeds. Based on research and field testing, Soviet scientists proposed the following species composition for the state forest shelterbelts:[7]

- First row – Canadian poplar, linden;
- Second row – ash, Tatarian maple;
- Third row – oak, yellow locust;
- Fourth row – ash, Norway maple;
- Fifth row – Canadian poplar, linden;
- Sixth row – ash, Tatarian maple;
- Seventh row – oak, yellow locust...

Among the shrubs, raspberries and currants were included to attract birds to combat forest pests.

Implementation and Results

[7] Последний удар Сталина - Сталинский план преобразования природы
https://www.forest35.ru/images/pdf/STALINSKIJ_PLAN_PREOBRAZOVAN.pdf

The Soviet Government established the institute “Agrolesproekt (in English Agroforestry project)” in 1948 to further develop and implement the plan. Its projects brought four major watersheds in the Dnieper, Don, Volga, and Ural rivers of European southern Russia under forest cover. The first state forest belt designed by Agrolesproekt stretched from the Ural mountain Vishnevaya to the Caspian coast, a length of more than a thousand kilometers. The total length of large state-owned shelterbelts exceeded 5,300 km. An area of 2.3 million hectares of forest were planted within these shelterbelts.

Simultaneously with the establishment of shelterbelt afforestation, a major irrigation system programme was launched. The USSR created approximately 4,000 reservoirs, holding 1,200 cubic kilometers of water. They made it possible to dramatically improve the environment, build a large system of waterways, regulate the flow of many rivers, obtain large amounts of cheap hydro-electricity, and use the accumulated water to irrigate fields and gardens.

By the end of 1951, shelterbelt forests had been planted on an area of over two million hectares, over 13,000 ponds and reservoirs had been created, and over 350 forest protection stations equipped with the most advanced technology had been organized. These measures resulted in a 25–30 percent increase in grain yields, 50–75 percent in vegetables, and 100–200 percent in yields of grass fodder. Also, increased capital investment in agriculture and improved technical equipment in collective and state farms made it possible to create a solid feed base for the development of livestock farming. As a result, the share of public livestock farming in collective and state farms in the production of livestock products increased significantly: in 1950, it amounted to 33 percent of meat, 25 percent of milk, and 11 percent of eggs.

But the death of the country’s leader, Joseph Stalin in 1953 brought to an abrupt end ongoing activities under the Plan. The incoming Soviet leader Nikita S. Khrushchev took a principled approach to draw a line under Stalin’s three decades-long rule and start a fresh beginning reflecting his own thoughts and approaches on the way forward for the Soviet Union’s development in the post-Stalin era. As part of that grand strategy the plan was rapidly wound down. Khrushchev ordered the closing of all forest protection stations. Forest belts were burned for firewood, and ponds silted up without proper maintenance. Scientific books on the transformation of nature were removed from libraries, as if the project were a mistake rather than a success.

Khrushchev opted for increasing grain production through expansion of arable land by ploughing millions of hectares of virgin land in semi-desert areas of Northern Kazakhstan and adjacent areas of Russia’s Siberia. It was an untested risky undertaking because these regions were risk-prone to environmental hazards, such as drought, sand storm/dust storm, soil erosion. The achievements as well as shortcomings of this programme have been discussed in the book “Virgin Land Development in the USSR”[8]. Intensive cultivation of untouched virgin lands in the open steppe led to significant increase in

[8] Indrajit Roy. 2026. Virgin Land Development in the USSR, available at https://archive.org/details/virgin-land-development

grain production. But it also triggered environmental degradation on a massive scale and the reckoning came quickly. The initial gains in food production couldn't be sustained. The Soviet Union again confronted shortages in domestic food production starting in 1963. In this context, Stalin's plan draws renewed interest. It was sustainable, nature-friendly, the increases in grain production were incremental but contributed to long-term gains in domestic food production and food security.

Discussion and conclusion

In the late 1940s, still reeling from the devastation caused by WWII, the Soviet Union tried an approach to agricultural development. It was pioneering for the rest of the world at that time. The essence of that approach was using Nature to modify climate on a regional scale and thus protect crop cultivation from the impact of extreme climate events. The key elements of that approach were planting trees on semi-desert and desert areas in layered rows to protect croplands in the European part of the USSR from the inflow of hot winds originating from Central Asia; planting trees to stop ingress of sands and prevent desertification of agricultural lands, introduction of nature-friendly farming practices such as growing grain crops in rotation with pasture crops, allowing bare fallows, stubble incorporation, a proper system of application of organic and mineral fertilizers, developing irrigation based on the use of local runoff water through the construction of ponds and reservoirs. All these with the passage of time became important constituent elements of the concept of sustainable agriculture that emerged in 1977 and later formalized by the FAO in the early 1990s.

Planting forest shelterbelts in rows and varying tree species composition and spacing among the rows created a stepped wind barrier. It not only reduced the wind speed but also forced it upward. This

prevented the topsoil from being blown away and also allowed the snow in the winter to be distributed evenly across the fields. Mass greening was expected to increase humidity and reduce average temperatures during the summer heat, effectively manipulating the weather on a regional scale. So, Stalin's plan was also called an environmental engineering project.

As highlighted above, one of the consequences of abandoning the plan and replacing it with monoculture-based extensive methods to increase arable land was the ecological disaster of 1962–1963. It was associated with soil erosion on virgin lands, and a food crisis erupted in the USSR. In the fall of 1963, bread and flour disappeared from store shelves, and shortages of sugar and butter began. In 1962, meat prices soared by 30 percent and butter by 25 percent. In 1963, due to a poor harvest and a lack of domestic reserves, the USSR, for the first time since the war, had to purchase approximately 13 million tons of grain abroad[9].

Over time, the emphasis on Stalin's political "mistakes" had completely obscured this grandiose programme, which was partially implemented by the United States, China, and Western Europe in the form of green belts. These are seen as playing a significant role in preventing the threat of desertification and global warming. For all Stalin haters, the irony is that Stalin not only conquered German fascism, he was also poised to conquer drought as well by transforming Nature. But he didn't get the chance to finish the job, death put an end to his dream just as the project was taking off the ground.

[9] Сергей Белов. СССР пытался подчинить природу с помощью лесов: зелёная стена дала стране изобилие продуктов.https://www.pravda.ru/science/2350112-stalin-nature-plan/, May 8, 2026